Kentucky

Agricultural Experiment Station

University of Kentucky

TWO IMPORTANT ENEMIES OF BLUEGRASS PASTURES

1. The Bluegrass Plant Bug
2. The Green Bug

BULLETIN NO. 265

RESEARCH BULLETIN

Lexington, Ky.

February, 1926.

(29)

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BULLETIN NO. 265

(Research Bulletin)

Two Important Enemies of Bluegrass Pastures

By H. GARMAN*

1. The Bluegrass Plant Bug (Miris dolobratus)

In early April, 1925, the bluegrass pastures of central Kentucky were observed by farmers and stockmen to be in bad condition and not providing the pasturage they generally do at that season of the year. Concern lest there should be a complete failure of both pasturage and seed crop became acute in the latter part of the month and the writer was urged to visit the region worst affected, about Paris in Bourbon county, to look into the trouble and learn whether or not injurious insects were at work on the grass. The weather was rather dry at the time and the rainfall had been below normal since January, when it was only slightly below, and diminished decidedly in March and April, just when it was most needed by bluegrass for the production of blades and panicles. As a result many acres of land on which good crops of seeds had been harvested in previous years showed only a short growth of stems with very small panicles, the latter not over a third of the size they should have been. Some very good pastures produced so little that it was finally decided not worth while to harvest the seeds from them at all. Fortunately there was at this time an exceptionally good growth of white clover in the pastures, and this forage supported grazing stock very largely until May, when on the 10th and 11th and again on the 16th some good rains fell and improved the growth of blue-

*Thanks are due to Messrs. Catesby Spears, Woodford Spears and Son, and W. A. Thomason, of Paris, for courtesies and assistance rendered the writer when studying injured pastures in Bourbon and Clark counties.

grass blades. The total precipitation for May finally proved a very small fraction above the average for the month in Bluegrass Kentucky, and improved the grass so much that stockmen had in June more pasture, they told me, than was needed. The rains came, however, too late to help the yield of seeds and one of the smallest crops* produced in recent years was harvested in June.

INSECTS AT WORK ON THE PASTURAGE

The failure of the seeds was not entirely due to the dry weather of early spring. An inspection of the pastures about Paris in April revealed the presence of two puncturing insects in large numbers, together with others not so common. The plant bug here treated was one of the very common ones. Of the worst two it was the more uniformly scattered in the pastures, and continued to increase in numbers until about harvest time, when the second insect (an aphid dealt with farther on) had disappeared. The injuries of the plant bugs began on the blades while the bugs were very young and were of greater consequence than they would otherwise have been because of the weakened condition of the plants resulting from the prevailing dryness. The injury to the seed crop is especially severe because of the disposition of this species to resort finally to the panicles and feed almost wholly on the immature seeds, at times gathering in such numbers as to give them a dark hue, readily perceived some distance away. Even when not thus noticeable, scores could be swept from the grass with a cloth net at any time during May and early June. When brought indoors and confined on bluegrass it continued the injuries, always puncturing and sucking the sap from the young seeds. The effect of its work could be recognized after a time by the fact that the injured panicles remained erect, when ordinarily toward the last they are disposed to droop as a result of the lengthening of the branches and the increasing weight of the seeds. Seeds actually harvested were not, however, as inferior in quality as was expected. A sample taken by the writer from a curing yard at

*Variously estimated by seedsmen as from 85,000 to 100,000 bushels; an average yield being somewhere near 700,000 bushels.

Paris, June 15, gave a germination of 39 per cent in July, when it was not yet thoroly cured, and late in the fall (November) gave the very satisfactory germination percentage of 87. Two other samples of Kentucky seed, sent to the Station at my request by Mr. J. S. Wilson, of Paris, germinated 83 and 87 per cent, respectively. The three samples thus give an average of 82.6 per cent, which is very good for seeds of this grass. The crop was thus reduced by the bugs not so much in quality as in quantity, and this can be understood as a result of the fact that puncturing the young seeds when in the "milk stage" doubtless destroys those attacked, while other seeds of the same panicle mature as usual and the few in number may be of better quality because of the "thinning" done by the bugs.

DESCRIPTION OF THE PLANT BUG

The adult pest is about 0.32 inch in length by about 0.08 inch in width, being thus somewhat slender. The sides are nearly parallel. The four wings of the adult are carried laid flat along the back. Antennae and legs are relatively long. The strong beak when not in use is carried folded back beneath the body and reaches about to the bases of the third pair of legs.

Two forms of the female occur, a long-winged and a short-winged. In the former and in the male, the wings extend to or slightly beyond the tip of the abdomen; in the short-winged female they cover only the front two-thirds or three-fourths of this part of the body. The young (nymphs) are wingless.

Fig. 1.—The adult bluegrass plant bug. Magnified 4.4 diameters.

The colors vary with age and in the adult with sex. Young are generally pale greenish, with dusky appendages; the adults have V-shaped black marks on the head, opening forward, a pair of black marks on the region of the body (thorax), just behind the head and some longitudinal dusky lines on the abdomen under and beyond the wings, and on the sides beneath. Males are more generally blackish than females, and the front wings are of a deep reddish color, not apparent in the female.

Long-winged Female. Length to the tips of folded wings, 0.33 inch. Fore wing, 0.268 inch long; hind wing 0.24 inch long.

Short-winged Female. Length to tip of abdomen 0.32 inch. Fore wings 0.16 inch long; hind wing (rudimentary) 0.09 inch long, triangular in outline.

Egg. Translucent whitish when fresh. Nearly cylindrical, curved, the free end evenly rounded, the attached end with a yellowish extension, thru which the young emerges. Length, .0484 inch; diameter at middle, 0.0053 inch. The extension at attached end striate, triangular in outline when the egg is removed from the stem and laid flat. The eggs are thrust into the central cavity of the stems, sometimes two or three close together, sometimes a dozen or more in a clump or series placed lengthwise of the cavity, the eggs projecting freely into the cavity, but retaining a close attachment to the inner wall of the stem at the point where the puncture was made by the bug.

HISTORY OF THE INSECT IN KENTUCKY

This enemy of bluegrass was first observed in Bluegrass Kentucky in 1908, when a few specimens were swept from a bluegrass pasture at Lexington. Its injurious nature was not apparent at the time. It gradually increased in numbers during the years following and examples were picked up here and there from time to time, tho it was not abundant enough to attract the attention of stockmen. Specimens were added to the Department Collection as follows: Lexington, May 23, 1908; Lexington, May 10, 1913; Lexington, June 13, 1913; Lexington, June 4, 1917; Pinckard, Woodford county, May 28, 1923; Versailles, Woodford county, May 29, 1924; Lexington, Paris and Winchester,

April-May, 1925. In 1924 came the first outbreak of the pest that drew the attention of seed handlers and stockmen. The adults were observed May 29 of that year in great swarms on the Taylor farm near Versailles, in Woodford county. As one traveled along the pike in the neighborhood of this farm the bugs could be seen blackening the grass. Complaints came in about this date from various sources in Woodford, Fayette and Bourbon counties, constituting the region in which the greater part of the blusgrass seeds are harvested. At this time the seed crop on 60 acres of the Taylor farm was destroyed, entailing a loss of something like $4,000, it was believed. The bugs disappeared as the seeds matured and nothing was seen of the insects again until April, 1925, when they were discovered in Bourbon county as young lurking in tufts of grass among the starting blades. They had not yet attracted the attention of farmers and seedsmen, tho the poor condition of the grass had been noted. Later in the spring they became very common everywhere in pastures, at Lexington, Paris and Winchester especially, and while more generally scattered than in 1924 did not gather in such large numbers on limited areas.

THE HISTORY OF THE BLUEGRASS PLANT BUG IN THE UNITED STATES

Its history in this country is peculiar in that while it appeared in Massachusetts over ninety years ago, having probably been brought to that state from Europe, it did not attract attention in the middle states until about 1892, when it was observed to have become numerous among grasses in Ohio.*

It was present in Illinois as early as 1883, a specimen in the Illinois State Laboratory Collection having been collected in that year in the central part of the state.

In New England where it first appeared it very gradually increased in numbers tho not attracting special attention, even of entomologists, until Professor H. Osborn of Ohio began to study it in 1914 as an enemy of timothy in Maine. Specimens are in the collection of the Boston Society of Natural History

*F. M. Webster, "Insect Life," Vol. 5, page 92.

collected in 1832, 1833 and 1834 at Cambridge, Massachusetts. The reason for the slow spread of the insect, as explained in a recent letter by Professor Charles W. Johnson, Curator of the Boston Society, is the shortness of the wings of a form of the female, which renders it practically unable to fly.

This explanation seems entirely reasonable in view of the fact that most of the females at the north and east are of the short-winged form (80 per cent according to Professor Osborn) and from experience north of the Ohio river this condition seems likely to continue in northern latitudes. The females collected

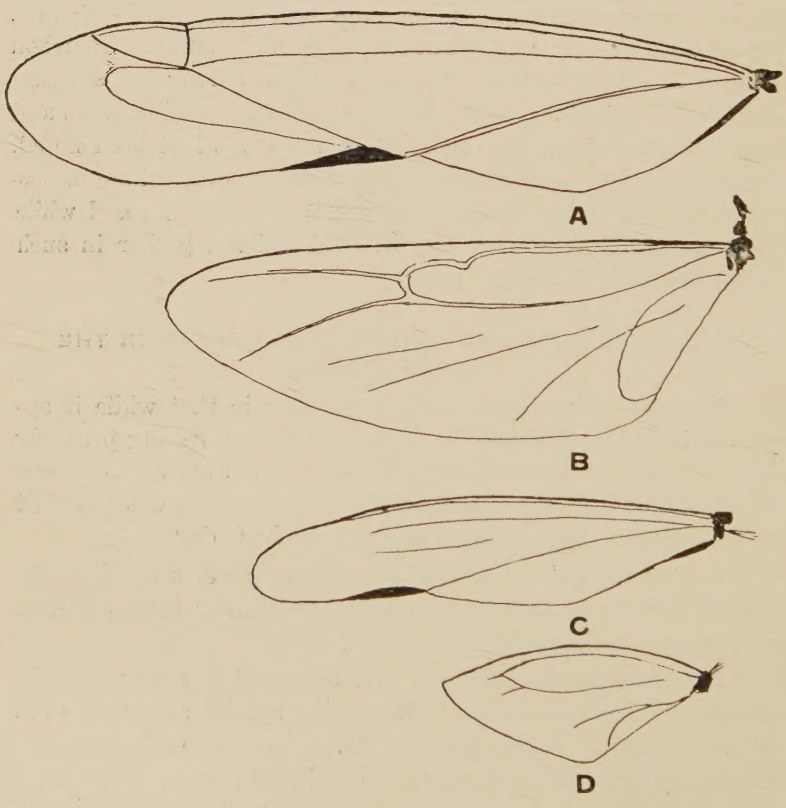

Fig. 2.—Wings of the two forms of the female plant bug. A, B, front and hind wing of long-winged female. C, D, front and hind wing of short-winged female. Magnified.

at the Illinois State Laboratory of Natural History in central Illinois were, some years ago, reported as exclusively short-winged. In Kentucky a different numerical relation between the forms has been observed. In the spring of 1925, the only season when this feature of the economy of the insect was closely observed, of ninety-nine specimens collected in the pastures at Paris and Lexington, 65 (65.65%) were males and 34 (34.34%) were females. Of the females, 14 (41.17%) were of the long-winged form and 20 (58.82%) were short-winged. Smaller collections made here at other times point in the same direction: On May 23, 1908, of three females collected, 2 were short-winged. On June 4, 1917, three females were collected, all long-winged. On May 28, 1923, three females were collected, again all long-winged. Adding these specimens to those collected in 1925 gives us the following proportions for Blusgrass Kentucky: Long-winged females 48.83%; short-winged females 51.16%.

It thus appears that enough long-winged individuals occur in this locality to render the dispersal more rapid southward and westward at our latitude than it has been at the north, and we may expect the insect to occupy the whole of Kentucky within a short period and perhaps in the next few years reach all the states south and west of us where bluegrass is grown.

ITS MEANS OF DISPERSAL

With its three pairs of relatively long legs the insect at all stages of growth can run about with some freedom. The long-winged males and females can, besides, use the well developed wings, which when folded extend beyond the body. The short-winged female has front wings that cover about two-thirds of the abdomen, but the hind wings are much shorter and slighter, mere vestiges in fact, and are of no service at all for locomotion. Where most or all of the females are short-winged, therefore, the dispersal must depend chiefly on the creeping movements by means of the legs and by such accidents as result in transporting insects from one place to another. In the case of some other pests these accidents play an important part in the spread of the species, due to peculiarity of habit, such as a disposition to hi-

bernate in straw or other loose material used as packing, but the Bluegrass Plant Bug appears not to have been greatly favored in this way, tho one would expect it to be transported at times in timothy hay if largely dependent, as it seems to be in Maine, on this forage plant.

THE LIFE HISTORY AS OBSERVED IN KENTUCKY

The young insects recently hatched from the eggs were common in bluegrass pastures as early as April 21 in 1925. They were swept in numbers from the longer growths of the grass at that date, in company with the Green Bug (*Toxoptera graminum*), a plant louse or aphid that attracted a good deal of attention some years ago in Kansas as an enemy of wheat. Most of the Bluegrass Plant Bugs were now in the first and second stages of growth, a few in the third and fourth. The young developed rapidly as the grass began to grow, and by May 26 most

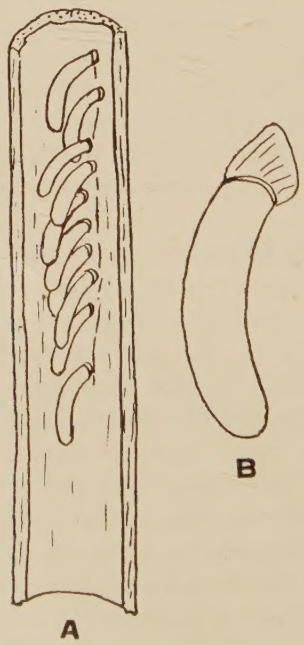

Fig. 3.—A, the eggs of the bluegrass plant bug as seen when a stem is cut open lengthwise; B, a single egg more highly magnified.

of them had matured and acquired wings, while perhaps twenty per cent were still in the third and fourth stages of growth. Only adults could be found from June 1 up to the time the adult insect disappeared, about the middle of June.

Eggs began to appear in bluegrass stems June 1 and were found in increasing numbers until about June 10th, remaining in these old stems when they became hard and dry and, after the seeds were stripped from them, were left in the pastures.

By June 15 the adults had become less common and on June 18 careful search for them at Lexington and Paris where they had previously been very common failed to reveal a single one.

It thus appears that they had either placed all their eggs and died after the crop of seeds was harvested or else had left the bluegrass and resorted to some other more succulent plant. There had previously been observed a disposition of the bugs to collect on the more succulent bluegrass in damp places as the spring advanced, but never at any time was there any inclination to leave bluegrass for other plants. From the observations made by Professor Osborn in Maine it was thought that orchard grass and timothy would attract the insects when bluegrass was no longer suitable as food. A large planting of timothy was in the midst of one of the worst infested bluegrass pastures in Bourbon county. It afforded an excellent opportunity to observe the work of the plant bug on this forage, upon which the writer, with Professor Osborn's experience in mind, was confidently expecting to find it. The heads of timothy were only beginning to push above the blades when the bluegrass seeds were harvested and a little later were in the best possible condition to attract the insects. They were examined and swept with a cloth net both before and after the bluegrass seeds were stripped and at no time could a single individual of this species be found on the heads. Nor were the bugs any more inclined to attack timothy at Lexington. On the Station grounds there is a good deal of orchard grass along one of the boundary fences, and some tufts elsewhere among the bluegrass. The bugs could always be taken in numbers from the bluegrass when it was developing, but did not visit the other grasses. A special trip was made to

the planting of timothy in Bourbon county when the heads were at their best and bluegrass tops were dry and mostly gone. The bugs had completely disappeared from bluegrass and had left the timothy untouched.

With a view to testing the preference of the bugs many were confined with timothy and orchard grass stems when these were still in a good condition for the placing of the eggs. When thus compelled to do so some of the bugs tried to place their eggs in the stems of orchard grass and timothy and sometimes succeeded, tho it appeared to be difficult for them to insert the ovipositor and in some instances eggs were actually left on the outside. When bugs were confined with bluegrass during early July eggs were easily obtained in the stems. Some of these eggs, and others obtained in pastures, have been kept ever since at the Station. None has hatched. Many bugs were confined June 5 with growing grasses under fine wire gauze. These grasses are still alive and in about the same condition as those out of doors. Judging by all the evidence obtained thus far, young should emerge from them in the spring of 1926.

It becomes evident from these observations that most of the eggs were placed out-of-doors in bluegrass stems. Search of these stems, some of them after the panicles had been removed by the strippers, showed that the eggs were still in the dry stems, and July 10 at Paris, on a spot where the bugs had previously been noted as particularly numerous, an examination of stems gave a percentage of 11.4 infested.

PLANTS ATTACKED BY THE BUG

No evidence has been obtained here indicating that the bug normally attacks anything but bluegrass. It was present on this grass from the time it started to grow in the spring until its seeds were harvested and later continued as eggs in the old stems. It did not attack white clover, tho this forage was at all times common in the pastures. It did not attack either orchard grass or timothy, except when it was confined with these grasses. Yet writing of the insect as observed in Maine, Professor Osborn says:

"This meadow plant bug has not been observed commonly on bluegrass (*Poa pratensis*) or other small grasses or grains with small seed heads, except as these are mixed with coarser forms. I believe it is quite strictly a grass-feeding species, primarily on timothy."

ENEMIES OF THE BLUEGRASS PLANT BUG

Except when very young and lurking among the tufts of blades in early spring the bug is not much exposed to fungus parasites, and while the plant lice with which it was associated were badly affected with a fungus (an Empusa), none of the young of the plant bug was observed to be attacked. At this time of year numerous small spiders lurk among the grass and were observed with plant bugs in their jaws. A small bug (*Nabis ferus*), observed at this Station for many years as an enemy of the corn-ear worm, spends the winter as an adult among bluegrass and is useful in the spring in destroying the plant bug. When the latter collects in vast numbers on the bluegrass panicles, as it did in Woodford county in 1924, it is especially open to the attacks of a Tachina fly, but this fly has not been observed attacking the pest in Kentucky. Doubtless all of these predatory species will increase in numbers if the plant bug continues troublesome, and it is probable that some of the fungi known to destroy other insects will attack the Bluegrass Plant Bug should the latter continue numerous.

OTHER INJURIOUS INSECTS PRESENT AMONG THE BLUEGRASS

From its manner of growth and the fact that it often remains green all winter, bluegrass affords a very acceptable lurking place for many insects. Some of these merely pass the winter about it because of the shelter it affords them and do little or no harm to the grass. The tobacco and egg-plant beetles, for example, can be found in our pastures during all of the fall, winter and early spring months, which explains why these pests are so troublesome in the tobacco plant beds when they are surrounded with rank growths of grass. But they are not known to do serious harm to the bluegrass blades or stems. A

third species of these beetles (*Chaetocnema pulicaria*), however, damages bluegrass and other grasses and grains, eating the blades freely, and has sometimes proved a troublesome enemy of young corn planted on sod land. It was common in October, 1925, in the pastures infested with plant bugs.

Thruout the spring months and again in the fall many insects of other sorts, more or less important either because of injury to the grass or because they are enemies of the injurious species, were common in the pastures. In April, small parasitic Hymenoptera were numerous, probably preying on the plant lice then present. They were observed again in the fall, at a time when plant lice of several other species appeared in the pastures.

In both spring and fall small striped caterpillars were frequent.

Of the flies, young and adults of the predatory Syrphus flies were common in the spring, while the adults of crane flies and of the wheat bulb worm (*Meromyza americana*) appeared in the fall.

Puncturing insects were very common in both spring and fall. At all inspections many leaf hoppers* (Jassidae mostly) were observed on the blades.

With these leaf hoppers were some other well known pests such as the Tarnished Plant Bug, and *Oncognathus binotatus, Plagiognathus obscurus,* and *Reutheroscopus ornatus.* Most of the beetles observed were roamers and beneficial species drawn to the grass because of the shelter it affords in winter, or attracted by the abundant food supplied them by the plant lice and plant bugs.

Some of the minute, slender thrips (Thysanoptera) were swept from the grass and may have done some mischief to the stems.

As the season advanced and in the fall members of the grasshopper order (Orthoptera) appeared, at first young of several small green species (Orchelimum sp.) and of the red-legged grasshopper (*Melanoplus femur-rubrum*). Late in the fall the

*The following were noticeable in May: **Deltocephalus sayi, D. inimicus, Athysanus curtisii, Diedrocephala mollipes;** in the fall the same species were presnt.

young of another grasshopper (*Chortophaga viridi-fasciata*) was observed in small numbers and will pass the winter in the pastures, the other species of grasshoppers being now in the soil, in the egg state.

Associated with the numerous small spiders lurking in the grass, was the common meadow mite (*Bryobia pratensis*) a troublesome little species not only from its injuries to forage plants, but because of its disposition to come into dwellings in large numbers, tho doing no recognizable harm there.

These species are recorded more for convenience in future observation than because of any relation of importance between them and the failure of the bluegrass crop. No doubt some of them had a share in reducing the growth of the grass. Further study may show that they had more influence of this sort than is now apparent.

TREATMENT

It is evident that we have here an insect capable of ruining the bluegrass seed crop if nothing prevents its further increase in numbers. Its life history as given above shows that it does much of its mischief when the seeds are immature and does no harm after the crop is stripped, remaining as eggs in the old grass stems during the summer and the following winter. It hatches in greatest numbers, therefore, among bluegrass that has not been close-grazed by stock—along fences, both inside and outside of pastures, and by roadsides, where stock is not permitted to roam. From my observations it places its eggs only in bluegrass stems, but those made in Maine imply that it also places its eggs in the stems of timothy and other grass species, and hence all old growths of grasses are to be regarded with suspicion as possible sources of infestation in the spring. It is believed not ordinarily to place eggs in the stems or petioles of clover, tho it has been known to make use of this plant and would do so in pastures if for any reason bluegrass stems were not available.

The facts thus seem to warrant the belief that getting rid of old growths of stems by any practicable means will reduce the

injury. The most obvious expedient is close grazing at all times in pastures that have been observed to be infested, for the old stems certainly contain the eggs for another brood of bugs.

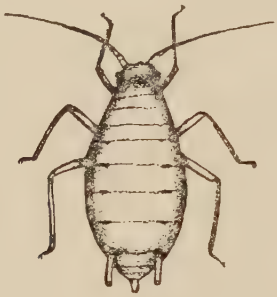

Fig. 4.—The green bug. Wingless agamic form. Magnified 17 diameters.

2. The Green Bug (Toxoptera graminum)

In 1907, 1916 and 1921, a small, soft-bodied sucking insect appeared in myriads in wheat fields west of the Mississippi river, notably in Kansas, but also in adjoining states and in small numbers in Kentucky and other sections of the Ohio valley. It was what is commonly called a plant louse or "aphis." In the newspapers of that period the name "green bug" was applied to it. Most aphids are green, and several other plant louse species and other predatory bugs attack small grains, hence the name has little to commend it as a means of recognizing the pest. Since its outbreak west of the Mississippi river it has attracted little attention, and while it has always been present in spring in Kentucky, its numbers have been so small, except in spots especially favorable to it, that few people have commented on it as an enemy of wheat or of any other grass crop. In April, 1925, when brown patches of bluegrass were observed in Bourbon and Clark counties stockmen and seedsmen not aware of its presence began to inquire as to the possibility of an insect being at work in the pastures. Examination showed this

little aphid present in large numbers in and about the injured grass. Sweeping one of the brown patches and the green grass at its margin with a cloth net collected them in a mass in the bottom of the net and it became evident that they had a large share in killing the grass in these places. Associated with them were the Bluegrass Plant Bug, dealt with in the preceding pages, and some other pests there mentioned, from which circumstance it was clear that while it was at this time chiefly concerned in the injury it was being helped by other sucking species. The Bluegrass Plant Bug was then hatching, or was recently from the egg, and the injury was largely completed, hence the Plant Bug cannot be charged with much of this early damage. The leaf hoppers that had hibernated in the pastures were at this time not common enough to have done a great deal of harm, from all of which it became evident that the aphid was chiefly the cause of the brown hue of the grass.

Many of the plant lice were winged at the time and were scattering from the pastures. Others were ready to acquire wings. In May they had completely disappeared from pastures, and careful search thereafter failed to reveal examples. When the pastures were again examined in October no specimens could be found tho several other plant lice were not uncommon.

The Bluegrass Plant Bug became common as this plant louse disappeared, as recounted in preceding pages. Later, it also disappeared, having died leaving its eggs in the bluegrass stems.

Putting the facts obtained in the rather brief time during which the insect was under observation, with those recorded by entomologists who studied the species in Kansas, it is plain that this insect works on the grass only during the early spring months and then disperses to establish itself during the summer months on some other plant or plants. It sometimes attacks other grasses, and from what is known of the alternation of host plants of plant lice it is fair to assume that it may have gone to wheat or oats. Some of the plants thought likely to harbor it at that time were searched, but it seemed to have disappeared from the neighborhood of the injured pastures.

That the insect spent the rest of the summer season on grasses or other plants in the bluegrass region cannot be doubted from what is known of its frequent occurrence in Kentucky. It was found at Lexington on oats May 26, 1890, and again on wheat at Christiansburg, November 20, 1899. April 28, 1912, Mr. David Prewitt, of Winchester, Kentucky, sent the writer specimens taken from bluegrass that had the appearance of being diseased, and on May 2, 1923, numerous specimens were received from Sparta, Gallatin county, where it was said to be injuring bluegrass. From these records made within the state and those made in the wheat fields of Kansas, it is probable that the insect lurks in small numbers on some one or several of the plants named and collects in our pastures only when bluegrass becomes green and succulent in early spring.

THE CAUSE OF ITS DISAPPEARANCE

The insects did not disappear merely by migrating to other plants. When most numerous on bluegrass a large percentage were noted as of a pinkish color and with the microscope were found infested with a parasitic fungus (Empusa sy.). The majority of those swept into the collecting net at times were infested, many of them already dead. Feeding on the plant lice were also many lady beetles (*Hippodamia parenthesis*) both as larvae and as adults, the species being not ordinarily the most common in Bluegrass Kentucky. It had no doubt been attracted by the abundant supply of its favorite food and was rapidly reducing the numbers of plant lice. Syrphus flies, also, well known enemies of the plant lice, were doing a share in lessening the numbers of aphides and altogether these predatory insects and fungi played an important part in clearing the pastures of the pest.

Whether or not those that undoubtedly escaped by flying will return in the early spring of 1926 remains to be seen. The plant louse is one of those accustomed to be active and injurious in rather cool weather. But it appeared from my inspection not to have returned in October.

ITS LIFE HISTORY

As with other plant lice, this species produced two forms, the one observed in our pastures, multiplying without the production of sexes (parthenogenetically) and a sexual, egg-laying form not yet observed here. Observers state that the egg-laying form appears at the north only in the fall of the year, and think it winters as an egg, nymph or adult, on the lower parts of the plants. South of the 35th parallel of latitude, except at high altitudes, which would exclude Kentucky, it has been suggested that it multiplies continuously on bluegrass thruout the year. It will require further observations to determine these features of the life history in this state. The facts thus far known indicate that, contrary to suggestions made by writers, it does not breed here on bluegrass during the summer months. We have no oats nor wheat in August, commonly, tho volunteer wheat may appear in the fall in some parts of the state.

TREATMENT

The aphis is most numerous on bluegrass in the rank tufts on low, moist ground and elsewhere in pastures and along roads wherever bluegrass has not been grazed closely. This condition of the grass is also exactly that favoring the Bluegrass Plant Bug. There is thus double reason for keeping such growths suppressed. Volunteer wheat and oats in the vicinity of pastures should be destroyed not only as a means of reducing the numbers of this aphid but because the practice helps to keep the Hessian fly suppressed, this wheat insect doing its worst injury to the earliest growths of wheat in the fall of the year. Plant lice are easily destroyed with strong tobacco extracts and by coal oil emulsion. When it is observed that the plant bug is getting started in restricted areas, spraying is entirely practicable as a means of preventing further multiplication and spread of the pests. It is only when they are widely scattered and excessively numerous that such treatment is not practicable.